

# Comparative Analysis of MIVAN Formwork Building and Conventional Formwork Building Based on Cost and Duration

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**Abstract :** The project involves detailed cost estimation and duration analysis of a building constructed by MIVAN formwork and Conventional formwork. The buildings are of G+21 floors where the saleable area of building with Mivan formwork is 8747.28 S.ft and that with Conventional Method is 9786.67 Sft on each floor with 3.0 m as the height of each floor. Later comparative analysis is done on cost and duration of both the buildings.

**Keywords:** MIVAN formwork, Conventional formwork, Detailed estimation, Duration, Comparison.

## I. INTRODUCTION

The progress made by the construction industry of any country could be considered as the index of development of that country. While there has been a progressive rise in stock of housing in India since independence, the speed thereof has not kept pace with the rapid growth of population and urbanization. As a result, the shortage of accommodation is increasing continuously and the situation has become acute in urban areas. The severity of the problem is critical especially in the metropolitan area and a classic example is Mumbai, the housing shortage is as high as 50 percent as against national average of 20 percent.

“For undertaking mass housing works, it is necessary to have innovative technologies which are capable of fast rate construction and are able to deliver good quality and durable structure in cost effective manner”.

One such technology is the MIVAN Technology!

The Mivan Technology was developed by Mivan Company Ltd from Malaysia in late 1990s as a system for constructing mass housing project in developing countries. The units were to be of cast-in-place concrete, with load bearing walls using a formwork of aluminum panels. To be erected by the hundreds, of a repetitive design, the system ensured a fast and economical method of construction. The concrete surface finish produced with the aluminum forms allows achievement of a high quality wall finish without the need for extensive plastering. This is one of the systems identified to be very much suitable for Indian conditions for mass construction, where quality and speed can be achieved at high level. The speed of construction by this system will surpass speed of most of the other construction methods/technologies.

## II. OBJECTIVES

- To estimate the ‘Quantities of material’ required for construction of building by both MIVAN formwork and Conventional formwork.
- To determine ‘Time’ required for completion of the building by both the above methods.

- To compare the cost of buildings based on the cost of material’s required in each of them.
- To compare the time required for construction of buildings considering the other influencing factors.
- To carry out comparative analysis between the two methods of construction and define suitable difference between them.
- To describe Advantages and Limitations of the methods under comparison based on comparative analysis.

## III. METHODOLOGY

The methodology adopted includes collecting the data from site’s and site visits, interviews, questionnaires to Project manager, Site engineers and workers, literature reviews, case studies, internet, book’s etc.

As the above work is based on a live project the Architectural plans and the Structural drawings for both the buildings have been obtained from the engineer’s in charge at the site.

The estimate of materials has been calculated by using the principles/method of Quantity estimation which can be stated as:

### A. Cubic contents method

‘Cubic Contents Method’ is used to find the volume of the work. In this method the LENGTH, WIDTH and DEPTH of the elements is multiplied to obtain the quantity of that element. In case of plastering and other surface works the surface area is found by multiplying the length with the width.

The rate/unit of the work is then multiplied with the quantity of the work to get the amount required to do the work. The rates in this project have been consulted by the engineers from purchase department. However it is also available in the latest DSR (DISTRICT SCHEDULE RATES)

### B. BAR BENDING SCHEDULE FORMULA (BBS FORMULA)

The BBS Formula is used to calculate the quantity of steel in the elements, by the following procedure:-

- Find Length of Reinforcement Bar used in the Element.
- Add Development length and bending length of the bar to get the Total length of the bar.
- Obtain the Number of bars required in that element by dividing the Length or Width of that element with the Spacing.
- Obtain the total length of the bar by multiplying the Total length of single bar with the number of bars required.

- Now find the weight per/unit of the reinforcing bar of a particular diameter by following formula-  $d^2/162$ , where  $d$ =diameter of the bar.
- Finally multiply the weight per/unit of that bar with the total length of the bar which gives the total weight of reinforcement in that element.

#### IV. PROBLEM STATEMENT

This study is done for a live project currently under construction at Hinjewadi phase-3, by PEGASUS PROPERTIES PVT.LTD. The details of the two buildings are as follows:

*A. MEGAPOLIS-MYSTIC( constructed with MIVAN formwork)*

1. Saleable area (total)- 183,693 S.ft
2. No of floors- 21F
3. Floor to floor height- 3.0 m

*B. SPLENDOUR HOMES (constructed with conventional formwork)*

1. Saleable area (total)- 205,520 S.ft
2. No of floors- 21F
3. Floor to floor height- 3.0 m

Detailed estimate for following items of work in Substructure and Superstructure is calculated:

- a- R.C.C work
- b- Shuttering work
- c- Steel
- d- Block-work (200mm, 150mm, 100mm)
- e- Fly Ash (200mm, 150mm, 100mm)
- f- Plastering work (Gypsum, single coat, external)
- g- Painting work (Internal, external)

#### V. RESULTS AND DISCUSSIONS

*A. Estimation Results of MIVAN formwork building(MYSTIC)*

1. Estimate of Materials

SR.NO	ITEM OF WORK	AMOUNT (Rs)
	<b>SUBSTRUCTURE</b>	<b>21336104</b>
1	R.C.C WORK	6928220
2	SHUTTERING	3593984
3	STEEL	9252880
4	BLOCK WORK	640985
5	FLY ASH	N.A
6	PLASTERING	640035
7	PAINTING	280000
	<b>SUPERSTRUCTURE</b>	<b>191430834</b>
8	R.C.C	55874335
9	SHUTTERING	52273020
10	STEEL	51089116
11	BLOCK'S	N.A
12	FLY ASH	N.A
13	PLASTERING	16915308
14	PAINTING	10118000
15	MISCELLANEOUS	<b>5161055</b>
	<b>TOTAL</b>	<b>212766937</b>

2. Estimate of Time for one floor of area 8747.28 S.ft (6 flats)

ACTIVITY	NO OF DAYS
All Shuttering	18
Steel Reinforcement	18
Concel electrification & plumbing	6
Allignment checking	3
Buffer time	2
Concrete placing	3
Removal of Vertical formwork	2
Removal of Other formwork	14
Lifting of wall panels	2
Gypsum plastering & painting etc	30
<b>TOTAL</b>	<b>98</b>

*Note:* In the above table, Vertical formwork refers to walls, columns & vertical sides of beams and, other formwork refers to Slabs, beam soffits & props to slabs etc.

3. Concluding results

- a. TOTAL COST= RS 212766937.00
- b. COST PER SQ.FT= RS 1,160.00
- c. DURATION PER FLOOR=98 DAYS
- d. TOTAL DURATION FOR SUPERSTRUCTURE= 2058 DAYS i.e 5.6 yrs.

*B. Estimation results of Conventional formwork building (SPLENDOUR HOMES)*

1. Estimate of Materials

SR.NO	ITEM OF WORK	AMOUNT
	<b>SUBSTRUCTURE</b>	<b>17346624</b>
1	R.C.C WORK	5313634
2	SHUTTERING	3517673
3	STEEL	5685030
4	BLOCK WORK	N.A
5	FLY ASH	1112460
6	PLASTERING	1252461
7	PAINTING	465365
	<b>SUPERSTRUCTURE</b>	<b>140379565</b>
8	R.C.C	27602195
9	SHUTTERING	29476823
10	STEEL	34354825
11	BLOCK'S	20500941
12	FLY ASH	327055
13	PLASTERING	24215831
14	PAINTING	3871894
15	MISCELLANEOUS	<b>30000</b>
	<b>TOTAL</b>	<b>157726188</b>

2. Estimate of Time for one floor of area 9786.67 S.ft (12 flats)

ACTIVITY	NO OF DAYS
Column shuttering	12
Column steel-reinforcement	12
Buffer	2
Beam & slab shuttering	15
Beam & slab steel placing	12
Levelling	3
Concrete placing	6
Removal of formwork	15
Brickwork	30
Plastering	30
Finishing	30
<b>TOTAL</b>	<b>167</b>

### 3. Concluding results

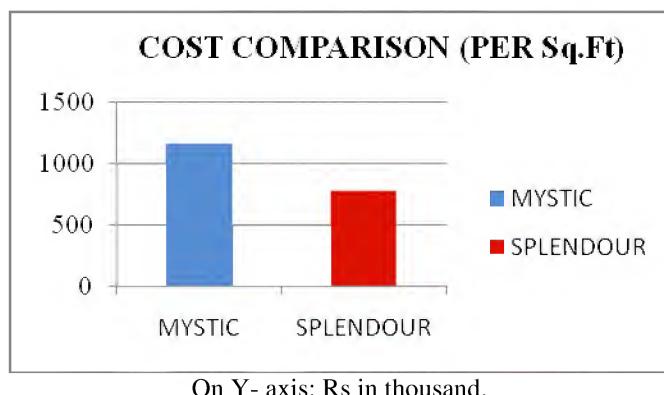
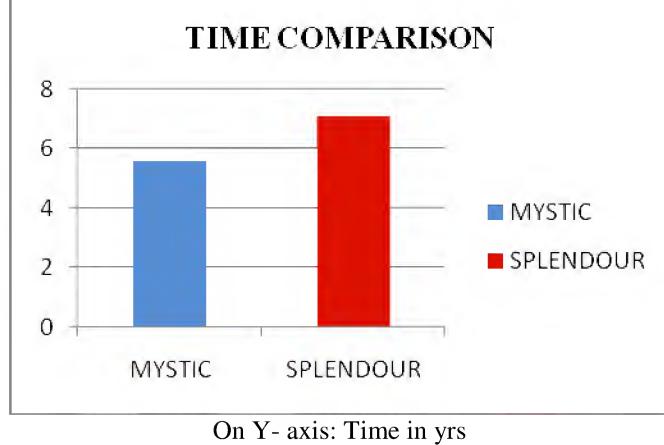
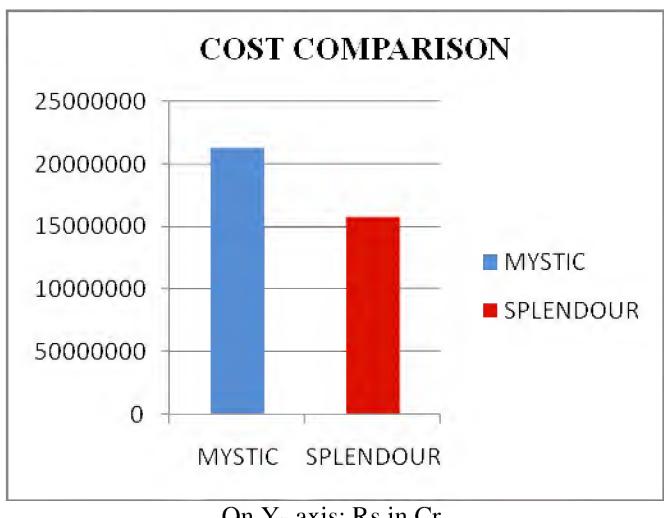
- TOTAL COST= RS 157726188.00
- COST PER SQ.FT= RS 768.00
- DURATION PER FLOOR=167 DAYS
- TOTAL DURATION FOR SUPERSTRUCTURE= 3507 DAYS or (2592 DAYS i.e 7.1 yrs)

*Note:* Here, according to 167 days per floor total number of days is 3507 for 21 floors. But, practically on site many activities are carried simultaneously so the time is reduced by a certain factor based on experience. Thus, 2592 Days.

## VI. RESULT COMPARISON

### A. Comparison of Cost and Duration.

From analysis of cost and duration for both the formworks the results of V- A & B can be compared graphically as:



*Note:* The comparison is based on per Sq.ft as the Saleable/floor area is different in both the cases. Also for comparison of time it is assumed that the number of workers and working hours on both the sites is constant.

### B. General comparison.

#### 1. Advantages of Mivan formwork over conventional construction.

- More seismic resistance- The box type construction provides more seismic resistance to the structure.
- Increased durability- The durability of a complete concrete structure is more than conventional brick bat masonry.
- Higher carpet area- Due to shear walls the walls are thin thus increasing carpet area.
- Faster completion- Unsurpassed construction speed can be achieved due to light weight of forms.
- Simplified foundation design due to consistent load distribution.

#### 2. Limitations of Mivan.

- Because of small sizes finishing lines are seen on the concrete surfaces.
- Concealed services become difficult due to small thickness of components.
- It requires uniform planning as well as uniform elevations to be cost effective.

- d. Modifications are not possible as all members are caste in RCC.
- e. Large volume of work is necessary to be cost effective i.e. at least 200 repetitions of the forms should be possible at work.
- f. The formwork requires number of spacer, wall ties etc. which are placed @ 2 feet c/c; these create problems such as seepage, leakages during monsoon.
- g. Due to box-type construction shrinkage cracks are likely to appear.
- h. Heat of Hydration is high due to shear walls.

## VII. CONCLUSION

From the above case study following conclusions can be made:-

1. Cost of construction with MIVAN formwork increases by almost 25-30 % as compared to the conventional method.
2. Cost of construction per.Sq.ft in MIVAN is as high as 33 % as compared to the Conventional Method.
3. The difference in per.Sq.ft cost of construction increases by almost 392 Rs/Sq.ft in MIVAN.
4. Duration of Construction in MIVAN is less than Conventional Method by almost 25 % and 534 days i.e 1.5 yrs.

Thus from the above points it is quite clear that construction by MIVAN formwork is quite expensive than the Conventional Method. However it can save considerable amount of time in construction of high rise building. Also, many of the finishing works is saved in Mivan which includes plastering (both internal and external), brickwork etc.

Monolithic casting of the members at one pour saves time and increases strength and durability and also makes it seismic resistant.

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